

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

MONITORING OF JUVENILE ANADROMOUS SALMONID
EMIGRATION IN THE SACRAMENTO RIVER
NEAR HAMILTON CITY, CALIFORNIA
JULY 2003 THROUGH JUNE 2004

by

Diane Coulon
North Central Region

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ABSTRACT

This report covers monitoring of juvenile Chinook salmon, (*Oncorhynchus tshawytscha*) trapped in an oxbow bypass channel from July 2003 through June 2004. The trap was downstream from the Glenn-Colusa Irrigation District water control structure at River Mile 205.5. The trap was operated 24 hours a day, seven days per week except during high water flow events and for trap repairs.

For the 2003/2004 sampling period, 10,939 juvenile winter-run Chinook salmon were captured at the oxbow site; 770 of those fish were adipose-fin clipped (ad-clipped). In addition, 47,536 other Chinook were captured (122 ad-clipped).

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INTRODUCTION

This report is an annual compilation of monitoring done from July 2003 through June 2004 at the Glenn-Colusa Irrigation District (GCID) fish screen bypass channel site off the Sacramento River. This site has been monitored since 1991. Although all species of fish captured in the trap were recorded (Table 5), the primary focus of this study was winter-run Chinook salmon.

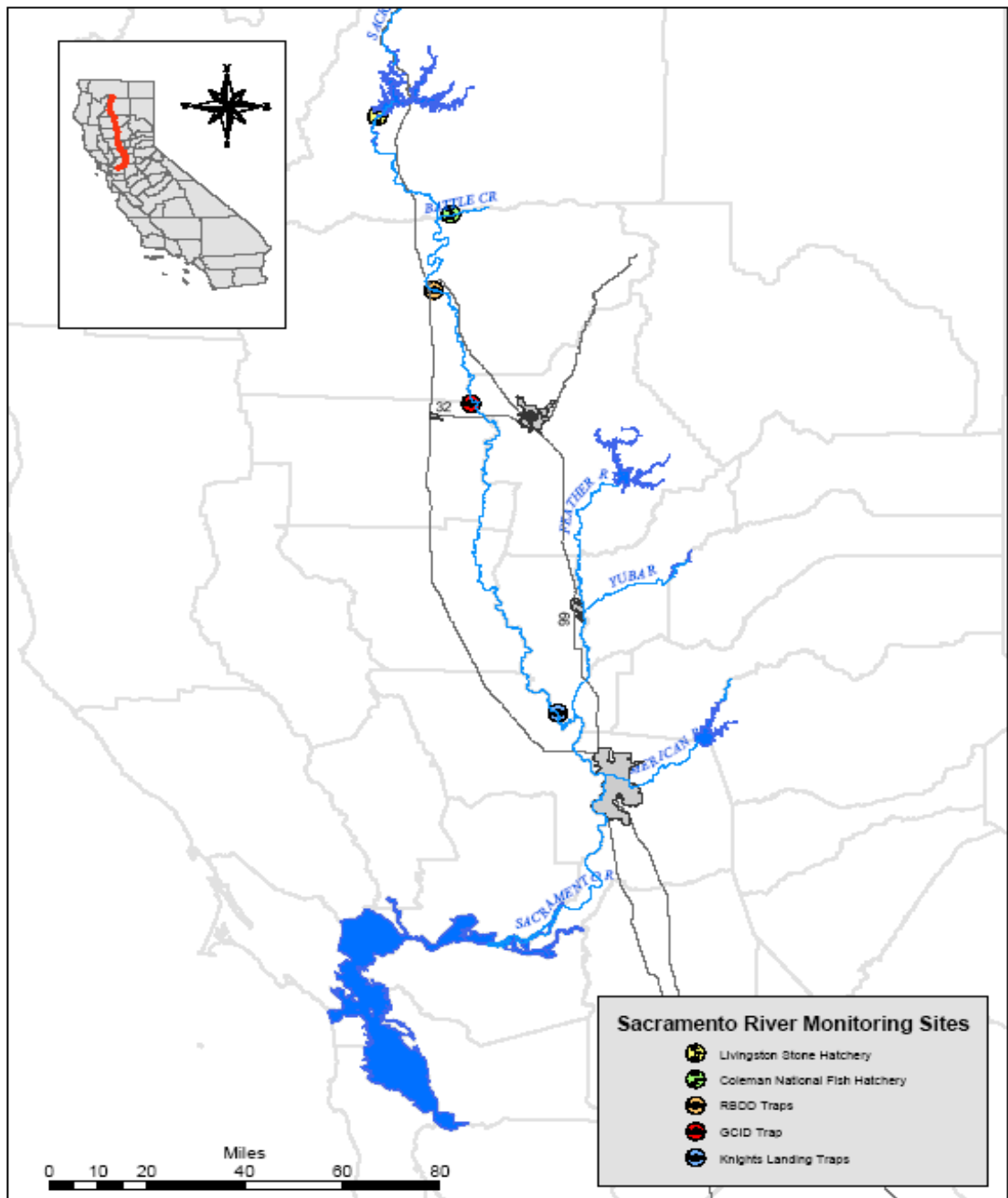
The winter-run Chinook salmon (WRCS), (*Oncorhynchus tshawytscha*), was listed as endangered under the Federal Endangered Species Act in January 1994, and State-listed as endangered in September 1999 under the California Endangered Species Act. Genetic research involving analysis of nuclear DNA has provided evidence that the Sacramento River winter-run Chinook salmon is distinct from other Chinook salmon in the Central Valley.

The U.S. Fish and Wildlife Service (USFWS) has a propagation program for WRCS at Livingston Stone National Fish Hatchery at the base of Shasta Dam. The program was suspended in 1996 due to concerns about potential hybridization with spring-run salmon and imprinting problems with juvenile winter-run Chinook salmon. In 1998, after considerable advances in genetic analyses to assure genetic integrity of artificially propagated WRCS, the program was re-authorized by the National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (DFG).

In addition to the GCID monitoring site, there are two other monitoring sites located on the Sacramento River:

1. Red Bluff Diversion Dam, River Mile 243. Monitoring conducted year-round by the USFWS, four 8' rotary screw traps.
2. Knights Landing, River Mile 88. Monitoring conducted nine months per year by the DFG, two 8' rotary screw traps.

Figure 1. Sacramento River juvenile salmon monitoring sites.



The Sacramento River system (Figure 1) which flows through California's Central Valley, is the principal producer of Chinook salmon caught in the state's ocean fisheries. There are four distinct runs of Chinook salmon in the Sacramento River system and are distinguished as follows:

1. Fall run. These salmon are the most numerous in the Sacramento River system. They return from the ocean during June through November and spawn from September through January.
2. Late-fall run. These salmon spawn in the upper Sacramento River an upstream of Red Bluff, arriving in November through February and spawning from January through April.
3. Winter run. These salmon spawn almost exclusively in the Sacramento River and tributaries upstream of Red Bluff, spawning from July through September.
4. Spring run. These salmon return to the river from the ocean from mid-February through June and spawn from August through October.

The GCID has been diverting Sacramento River water since 1883. The GCID conveys Sacramento River water through irrigation canals to approximately 141,000 acres of agricultural land and delivers water to 20,000 acres of wildlife habitat comprising the Sacramento, Delevan and Colusa national wildlife refuges.

The GCID's Hamilton City pump station is located approximately 100 miles north of the City of Sacramento. The pump station is situated on an oxbow off the main stem of the Sacramento River at River Mile 205.5. Water flow passes through the approximately 1,100 foot length of flat plate fish screen where a portion of the water is pumped into GCID's main irrigation canal. The remaining flow in the oxbow passes by the screens and then back into the mainstem of the Sacramento River.

The GCID diverts a maximum of 3,000 cfs from the Sacramento River, with the peak demand occurring in the spring. Because GCID diverts up to 25 percent of the Sacramento River flow at Hamilton City, its pumping operations were identified as a significant impediment to the downstream migration of juvenile Chinook salmon. All four runs of salmon have declined over the past 25 years. One reason for the decline was the poor performance of an existing 20-year old drum screen. In August 1993 an interim flat-plate screen was installed across the trashrack in front of the rotary drum screen. The bypass return channel was altered to reduce the time it takes for fish to return to the river. In May of 1998, construction was begun on an approximately 520-foot extension to the existing 600-foot fish screen and three bypass structures were installed from the screens to the oxbow bypass channel. Construction was completed in May 2002.

MATERIALS AND METHODS

Trapping Site

Fish were trapped in an oxbow bypass channel of the Sacramento River. The site was approximately 300 feet downstream from the flat-plate fish screen structure and 100 feet downstream from the water control structure. Sampling was conducted using one 8-foot diameter rotary screw trap (RST) with a live box measuring 4'x4'x3' manufactured by EG solutions (Eugene, Oregon). Steel cable (1/4 inch diameter) connected the RST to a 1/2 inch steel high-line cable suspended across the channel and anchored on the opposite banks by secured tower structures. The trap was fished 24 hours per day, seven days a week, except during extraordinarily high water flows or during periods of excessive debris (Table 1).

Processing Captured Fish

All fish were netted from the live box and placed into a shallow tub of river water. A subsample of approximately 50 salmon juveniles was placed in a bucket containing a solution of tricaine methanesulfonate (MS-222) and anesthetized (Nine grams of MS-222 powder are dissolved in one liter river water). Upon mobilization, the juveniles were individually placed onto a plexiglass measuring board and measured to the nearest mm fork length. Salmon race was determined using size-at-time criteria developed by Frank Fisher (DFG), Northern California, North Coast Region, unpublished data). After the subsample of 50 juvenile salmon were measured, all the juvenile salmon not anesthetized or measured were grouped and counted according to race (Table 2) and it was noted if the fish was ad-clipped (Table 3). The first ten of each non-salmonid fish species were anesthetized and measured to the nearest mm fork length, and the remainder were not anesthetized or measured but were counted. All other species captured were recorded (Table 5). After full recovery, all fish were transported downstream by boat and released into the mainstem Sacramento River at approximate River Mile 206.

Results

This report is quantitative and does not predict future spawner populations. The data gathered in this monitoring project is used to determine trends in the numbers, timing, and presence of the Chinook salmon runs and threatened and endangered fishes.

The daily data obtained from the Glenn-Colusa fish screen bypass canal trap from January 1, 1996 to the present has been entered into the California Department of Water Resources Interagency Ecological Program's database and is available on the internet at <http://BayDelta.water.ca.gov>.

Table 1. Trap operation July 2003 through June 2004.

July 2003 – Trap in operation 22 days. No sampling conducted nine days.

- 07/02 – GCID screen performance study.
- 07/04 – GCID screen performance study.
- 07/09 – GCID screen performance study.
- 07/11 – GCID screen performance study.
- 07/16 – GCID screen performance study.
- 07/18 – GCID screen performance study.
- 07/23 – GCID screen performance study.
- 07/25 – GCID screen performance study.
- 07/30 – GCID screen performance study.

August 2003 – Trap in operation 22 days. No sampling conducted nine days.

- 08/01 – GCID screen performance study.
- 08/06 – GCID screen performance study.
- 08/08 – GCID screen performance study.
- 08/13 – GCID screen performance study.
- 08/15 – GCID screen performance study.
- 08/20 – GCID screen performance study.
- 08/22 – GCID screen performance study.
- 08/27 – GCID screen performance study.
- 08/29 – GCID screen performance study.

September 2003 – Trap in operation 28 days. No sampling conducted two days.

- 09/03 – GCID screen performance study.
- 09/05 – GCID screen performance study.

October 2003 – Trap in operation 31 days.

November 2003 – Trap in operation 30 days.

December 2003 – Trap in operation 16 days. No sampling conducted 15 days.

- 12/07 through 12/16 – Trap repairs, heavy debris, high flows.
- 12/24 through 12/31 – High flows, heavy debris.

January 2004 – Trap in operation 16 days. No sampling conducted 15 days.

- 01/01 through 01/13 – High flows, heavy debris.
- 01/28 through 01/29 – Trap repairs.

February 2004 – Trap in operation 13 days. No sampling conducted 16 days.

- 02/03 through 02/05 – High flows, heavy debris.
- 02/17 through 02/29 – High flows, heavy debris.

March 2004 – Trap in operation 18 days. No sampling conducted 12 days.
03/01 through 03/12 – High flows, heavy debris.

April 2004 – Trap in operation 25 days. No sampling conducted five days.
04/16 through 04/17 – Extreme debris from upstream dredging.
04/26 through 04/28 – Extreme debris from upstream dredging.

May 2004 – Trap in operation 20 days. No sampling conducted 11 days.
05/01 through 05/02 – Extreme debris from upstream dredging.
05/05 – GCID screen performance study.
05/07 – GCID screen performance study.
05/09 – Excessive debris.
05/12 – GCID screen performance study.
05/14 – GCID screen performance study.
05/16 – GCID screen performance study.
05/19 – GCID screen performance study.
05/21 – GCID screen performance study.
05/28 – GCID screen performance study.

June 2004 – Trap in operation 20 days. No sampling conducted 10 days.
06/02 – GCID screen performance study.
06/04 – GCID screen performance study.
06/09 – GCID screen performance study.
06/11 – GCID screen performance study.
06/16 – GCID screen performance study.
06/18 – GCID screen performance study.
06/23 – GCID screen performance study.
06/25 – GCID screen performance study.
06/28 – GCID screen performance study.
06/30 – GCID screen performance study.

Table 2. Unmarked juvenile Chinook salmon recoveries at the Glenn-Colusa Irrigation District bypass channel July 2003 through June 2004. Fish were assigned to race based on size-at-time criteria developed by Frank Fisher (California Department of Fish and Game, Northern California – North Coast Region, unpublished data).

Time Period	Winter-run	Spring-run	Fall-run	Late fall-run
July 1-15	0	0	151	3
July 16-31	11	0	170	11
Aug. 1-15	38	0	87	17
Aug. 16-31	152	0	31	19
Sept. 1-15	265	0	1	4
Sept 16-30	3,911	0	3	22
Oct. 1-15	1,975	0	2	25
Oct. 16-31	1,932	129	3	25
Nov. 1-15	1,153	22	2	44
Nov. 16-30	398	5	0	23
Dec. 1-15	209	6	1	19
Dec. 16-31	48	62	747	4
Jan. 1-15	0	2	143	0
Jan. 16-31	3	5	6,888	0
Feb. 1-15	19	6	8,111	0
Feb. 16-29	0	0	269	0
Mar. 1-15	20	19	394	0
Mar. 16-31	33	133	967	0
Apr. 1-15	0	144	326	8
Apr. 16-30	2	3,245	20,049	1
May 1-15	0	11	2,680	0
May 16-31	0	0	1,508	0
June 1-15	0	0	679	0
June 16-30	0	0	188	0
TOTAL	10,169	3,789	43,400	225

Table 3. Adipose fin-clipped juvenile Chinook salmon recoveries at the Glenn-Colusa Irrigation District bypass channel July 2003 through June 2004. Fish were assigned to race based on size-at-time criteria developed by Frank Fisher (California Department of Fish and Game, Northern California – North Coast Region, unpublished data).

Time Period	Winter-run	Spring-run	Fall-run	Late fall-run
July 1-15	0	0	0	0
July 16-31	0	0	0	0
Aug. 1-15	0	0	0	0
Aug. 16-31	0	0	0	0
Sept. 1-15	0	0	0	0
Sept 16-30	0	0	0	0
Oct. 1-15	0	0	0	0
Oct. 16-31	0	0	0	0
Nov. 1-15	0	0	0	0
Nov. 16-30	0	0	0	0
Dec. 1-15	0	0	3	53
Dec. 16-31	0	0	0	0
Jan. 1-15	0	0	0	0
Jan. 16-31		0	0	0
Feb. 1-15	768	23	1	26
Feb. 16-29	0	0	0	0
Mar. 1-15	0	7	0	0
Mar. 16-31	2	0	7	0
Apr. 1-15	0	0	0	0
Apr. 16-30	0	0	0	0
May 1-15	0	0	2	0
May 16-31	0	0	0	0
June 1-15	0	0	0	0
June 16-30	0	0	0	0
TOTAL	770	30	13	79

Figure 2. Summary of unmarked Chinook salmon recoveries in the Department of Fish and Game's rotary screw trap located at the GCID fish screen facility, July 2003 through June 2004.

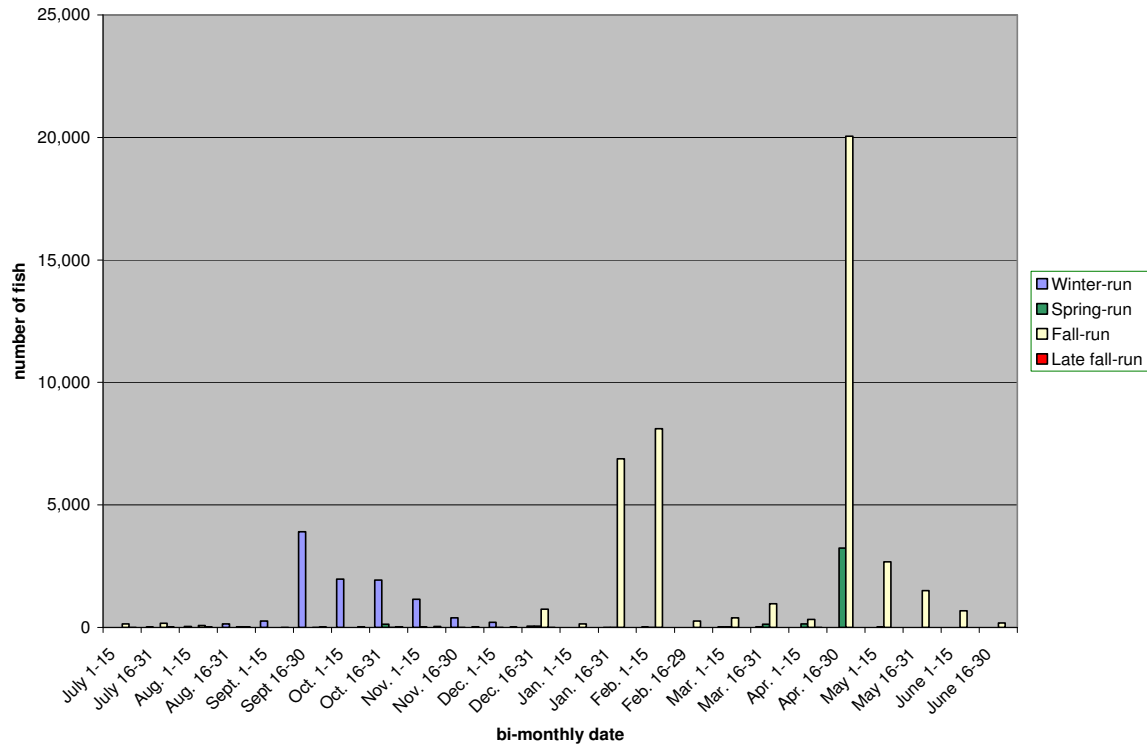


Figure 3. Summary of marked Chinook salmon recoveries in the Department of Fish and Game's rotary screw trap located at the GCID fish screen facility, July 2003 through June 2004.

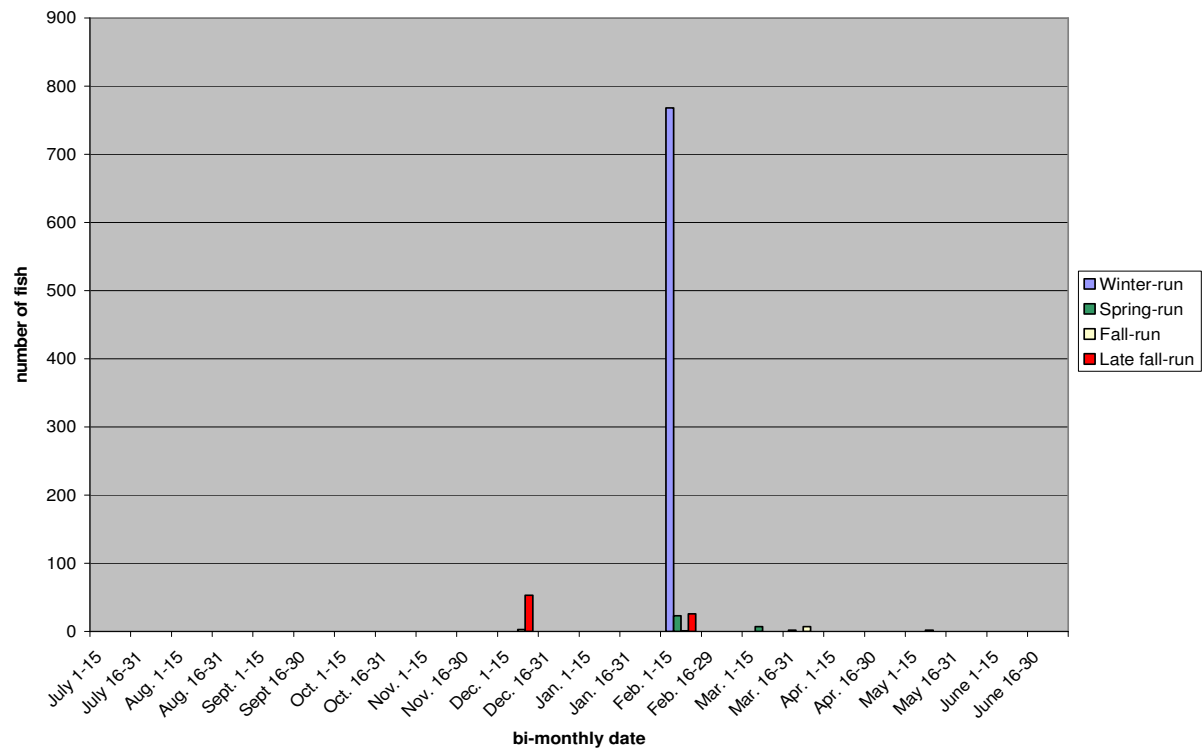


Table 4. GCID bypass channel other species inventory.

Acipenseridae

sturgeon (*Acipenser spp*)

Catostomidae

sucker, Sacramento (*Catostomus occidentalis*)

Centrarchidae

bass, largemouth (*Micropterus salmoides*)

bass, smallmouth (*Micropterus dolomieu*)

bluegill (*Lepomis macrochirus*)

crappie, black (*Pomoxis nigromaculatus*)

crappie, white (*Pomoxis annularis*)

sunfish, green (*Lepomis cyanellus*)

sunfish, redear (*Lepomis microlophus*)

Clupeidae

shad, American (*Alosa sapidissima*)

shad, threadfin (*Dorosoma petenense*)

Cottidae

sculpin (*Cottus spp*)

Cyprinidae

carp, common (*Cyprinus carpio*)

hardhead (*Mylopharodon conocephalus*)

hitch (*Lavinia exilicauda*)

roach, California (*Hesperoleucus symmetricus*)

shiner, golden (*Notemigonus chrysoleucas*)

splittail (*Pogonichthys macrolepidotus*)

pikeminnow, Sacramento (*Ptychocheilus grandis*)

dace, speckled (*Rhinichthys osculus*)

Embiotocidae

perch, tule (*Hysterocarpus traski*)

Gasterosteidae

stickleback, threespine (*Gasterosteus aculeatus*)

Ictaluridae

bullhead, brown (*Ictalurus nebulosus*)

catfish, channel (*Ictalurus punctatus*)

catfish, white (*Ictalurus catus*)

Petromyzontidae

Lamprey (*Lampetra spp*)

Poeciliidae

Mosquitofish, western (*Gambusia affinis*)

Salmonidae

salmon, Chinook (*Oncorhynchus tshawytscha*)

trout, rainbow (*Oncorhynchus mykiss*)

Table 5. Monthly summary of other species captured in the Department of Fish and Game's rotary screw trap located at the GCID fish screen facility, July 2003 through June 2004.

SPECIES	July	August	September	October	November	December	January	February	March	April	May	June	TOTAL
bass, largemouth	2	2	6	2	0	1	1	0	1	3	0	6	24
bass, smallmouth	0	1	3	1	2	3	0	0	0	0	3	0	13
bluegill	5	5	4	0	18	13	3	4	10	6	9	4	81
bullhead, brown	0	0	0	0	0	0	0	1	4	0	0	0	5
carp, common	0	0	0	0	0	1	0	0	1	0	0	0	2
catfish, channel	0	0	0	2	0	1	0	0	0	1	1	0	5
catfish, white	1	0	4	1	0	0	0	0	0	0	0	1	7
crappie, black	0	0	0	0	0	0	0	0	3	4	2	1	10
crappie, white	0	0	0	0	0	0	0	0	0	0	0	0	0
dace, speckled	0	0	0	0	0	0	0	0	2	0	0	0	2
fathead minnow	0	0	0	0	0	0	0	0	0	0	0	0	0
hardhead	7	17	10	2	5	2	3	2	15	13	33	14	123
hitch	0	0	0	0	1	0	0	0	0	0	0	0	1
Lamprey	83	23	23	37	25	1	0	3	12	34	43	22	306
Mosquitofish, western	32	7	2	0	1	1	1	0	1	6	2	0	53
perch, tule	2	0	1	0	0	12	0	1	3	2	0	1	22
pikeminnow, Sacramento	764	744	37	8	47	53	26	25	120	221	114	340	2499
roach, California	0	0	0	0	0	0	0	0	0	0	0	0	0
sculpin, prickly	5	5	2	2	1	1	2	8	85	35	8	12	166
sculpin, riffle	0	0	0	0	0	0	0	0	1	6	1	0	8
shad, American	1	8	1	0	0	0	0	0	0	0	0	3	13
shad, threadfin	0	0	0	0	2	0	0	0	0	3	1	2	8
shiner, golden	15	8	0	0	1	15	2	2	1	1	3	13	61
splittail	0	0	0	0	0	0	0	0	0	0	1	0	1
stickleback, threespine	0	0	0	8	2	0	0	2	4	1	2	0	19
sturgeon (unidentified)	3	1	1	0	0	0	0	0	0	0	1	3	9
sucker, Sacramento	29	38	54	463	52	11	1	5	2	8	549	133	1345
sunfish, green	1	2	1	1	2	2	0	0	0	0	1	0	10
sunfish, redear	0	0	1	0	0	1	0	0	0	0	0	0	2
trout, rainbow (unmarked)	1	1	5	5	0	0	1	1	12	4	5	3	38

